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A STUDY ON BODY WEIGHT AND MEASUREMENTS OF SOME FAT-TAILED IRANIAN SHEEP BREEDS

I – SOME SOURCES OF VARIATION AFFECTING BODY WEIGHT AND MEASUREMENTS OF KARAKUL, MEHRABAN, NAEINI, GHEZEL AND BAKHTIARI EWES[1]

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ABSTRACT

Least-squares analyses were made on body weights of ewes at mating, lambing and weaning time, and on ten body measurements. A total of 2, 519 records of body weight at mating season consisting of 524 Karakul, 875 Mehraban, 505 Naeini, 305 Ghezel and 310 Bakhtiari ewes were used. Breed, age of ewe, year of recording (1973 through 1975, inclusive) and type of rearing (purchased animals versus those reared in the Station) were considered as the main factors for analysis of body weights. Body measurements were taken only on 1,087 ewes in 1975.

The main factors had highly significant effects ($P < .01$) on body weights at mating, lambing and weaning time. All breeds were significantly different from each other in body weight at mating time. Ghezel was the heaviest breed followed by Mehraban, Bakhtiari, Karakul and Naeini ewes. Least-squares means of mature ewe weights (five-year-old) at mating season indicated that Ghezel could be classified as a heavy breed (59.1 kg), Mehraban, Bakhtiari and Karakul as medium (54.2, 53.3 and 51.0 kg,

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respectively) and Naeini as a small breed (43.4 kg).

The one-and-half year old ewes were the lightest age group at mating season and body weight increased significantly and reached its maximum at the age of four and a half years, then remained the same up to seven and a half years of age. The ewes which were born in the College Station and were creep-fed, were significantly heavier at mating, lambing and weaning time, compared with those which were born in their original areas and purchased for the establishment of the flock.

Breed had highly significant effects on 9 out of 10 body measurements studied ($P < .01$). Ghezel was the largest and Naeini was the smallest among the breeds in most of the comparisons. Age and type of rearing had highly significant effects on most of the measurements. Creep-fed animals exceeded the purchased group in all the measurements.

INTRODUCTION

It has been estimated that less than one-fifth of the 100 million hectares of Iran's rangeland can be classified as fair to good,i.e. with 450 kg of forage production per hectare per year (1, 11). Although about 70% of the total feed requirement of Iran's livestock population is provided by natural forage, the carrying capacity of the usable ranges is estimated to be enough for only 20 million sheep units. However, the grazing load carried by these rangelands appears to be about four times (80 million sheep units) their grazing capacity (11).

It is well known that for optimum lamb and wool production, there should be a balanced relationship between body size and available feeds. The larger sheep naturally

require greater amounts of feed and while heavier ewes produce greater amounts of lamb meat and wool (8, 9, 10, 12, 13) than lighter ewes, it is important to study the efficiency of production with respect to body weight. The feed requirement-size production relationship should receive special attention in selection programs particularly in this country, where sheep suffer from the low forage production of the rangelands and ranges are generally overgrazed.

The purpose of this study was to evaluate the relative importance of some environmental factors affecting body weight and dimensions of the five Iranian sheep breeds in different seasons, and to compare the body weight and dimensions of these breeds.

MATERIALS AND METHODS

Breeds: This study involved five fat-tailed carpet-wool Iranian breeds of sheep including Karakul, Mehraban, Naeini, Ghezel and Bakhtiari. The flock establishment and the characteristics of the breeds are described by Farid and Makarechian (3) and by Makarechian, Farid and Sefidbakht (7). In summary, in order to perform a crossbreeding and breed comparison experiment, a flock of Karakul, Mehraban and Naeini was established at Badjgah, 16 km north of Shiraz, in 1971 and Ghezel and Bakhtiari breeds were introduced in 1973. Karakul, Naeini and Bakhtiari are range sheep and are managed under migratory system, whereas Ghezel and Mehraban are mainly farm sheep.

Management of the Flock: All sheep involved in this study were from the Animal Research Station flock. The breeding season generally started in late September and lasted for about six weeks every year except in 1972 in which it started on July 20. The ewes were first mated when they were approximately one and a half years old. Lambing usually occurred during late February. Groups of ewes were kept in pens with their

lambs for about five days after parturition; then the ewes were taken out for grazing and the lambs were separated and kept in the barn. In 1972, the lambs had access to the ewes only for about 12 hours during the night, but in subsequent years, the lambs were kept with their dams during the afternoon through the next morning and the ewes were out for grazing only in the morning. All the lambs were creep-fed and were weaned around 75 days of age. The ewes were not milked. Shearing was done in late April each year; since most of the ewes were nursing their lambs at this time, the body weights of ewes at mating and lambing time were measured when the animals were carrying 5-and 11-month wool growth, respectively, but body weight at weaning was measured when most of the ewes had been sheared. No adjustment for wool-carrying status of the animals was made on the data. The animals were housed during the nights regardless of the season. No classical selection for production traits has been performed on these animals.

Feeding: The sheep were usually run in flocks of about 350 head. The sheep were generally grazed on range and fields in which no measure of feed intake was available. The range was very poor in vegetation and became dry and unpalatable during the late fall and winter months. The animals were grazed on barley pasture during April, for about a month, when the ewes were still nursing their lambs. There were also some barley and wheat stubbles available during the summer months, and some corn stubbles and alfalfa during late summer and early fall.

Although it was intended to provide a uniform feeding schedule over the successive years, rations were changed to some extent because of fluctuation in the climatic conditions and economical considerations. The available area of the rangeland and field residuals were small compared with the number of the animals; consequently the grazing period was very short. During late fall and winter, grazing was on range and was limited daily from morning until noon. This continued until the animals were put on barley pasture. Grazing time was increased to day length on field residuals in the spring and

summer. Adequate supplemental feed was supplied for approximately seven months each year particularly before and after lambing, at mating season and during inclement weather. The ewes were maintained in excellent condition and at no time could be considered thin except around weaning time. Flushing started about 15 days before mating with about 300 g barley and 400 g alfalfa hay per head per day as supplemental feed and continued until the end of mating season. The supplemented feed was reduced to 200 g hay and 400 g dried sugarbeet pulp daily until 6 weeks before lambing when each ewe was supplemented with 300 g dried beet pulp, 250g barley and 400g alfalfa hay. Corn silage and/or wheat straw were also fed depending on grazing period and range condition. About 100 g dried beet pulp, 100g barley and 200g alfalfa were added to the previous supplemental ration during the nursing period until the animals were out on barley pasture when supplemental feeds were limited to 300 g dried beet pulp. After weaning, the ewes were grazed without any supplementation, except in 1972 when the ewes received 300g alfalfa hay per day. The amount of supplemental feed in the other seasons in 1972 was lower since field and range area per each ewe were greater compared with those in the subsequent years.

The ewe lambs were supplemented with at least 250g alfalfa hay and 100g barley per head per day after weaning, in addition to daylength grazing, and supplemental feeds were increased as the grazing time was shortened. This system of feeding continued until the mating season.

Source of the Data: A total of 2, 519 records of ewe body weight at mating season, including 524 Karakul, 875 Mehraban, 505 Naeini, 305 Ghezel and 310 Bakhtiari were used. In addition, 1, 651 records of ewe body weight at lambing and 1,558 records of body weight at weaning time were utilized in this study. Body weights were taken in 1973 through 1975, inclusive. Data on body weights of ewes at breeding season in 1972 which lambed in 1973 were not available. The ewes' body weights were recorded within 12 hours of lambing. The data on ewes which had twin births and on those which had

not conceived were excluded from the lambing and weaning data.

A few days before the breeding season in 1974, the body dimensions of 1,087 ewes, as well as their body weights, were measured. The measurements were obtained as follows (Fig. 1):

1. Height at withers
2. Width at breast, horizontal distance between two humeri
3. Length, front of withers to hook bones
4. Width of shoulder
5. Width of body at mid-side
6. Hook width, horizontal distance between two tuber coxae of the pelvis
7. Depth of chest
8. Depth of body, deepest point
9. Circumference of chest (heart girth)
10. Circumference of body, largest point

The measurements were taken by plastic tape and by set-square. The weights were measured to the nearest 50 grams and body measurements to the nearest 0.5 centimeter.

Analysis of Data: Least-square analysis of variance (5) was used to study the effect of breed, age of ewe, year of recording and type of rearing on body weight of ewes. In order to analyze body dimensions, constants were fitted for breed, age and type of rearing. Records of seven-year-old ewes (7.5 year-old at mating season) were added to the records of six-year-old ewes because of the small number of observations. Variation due to rearing type resulted from the difference between the rearing type of ewes which were born in the original ranges (Naeini, Bakhtiari and Karakul) or farms (Mehraban and Ghezel) and those which were born in the College Station. The latter

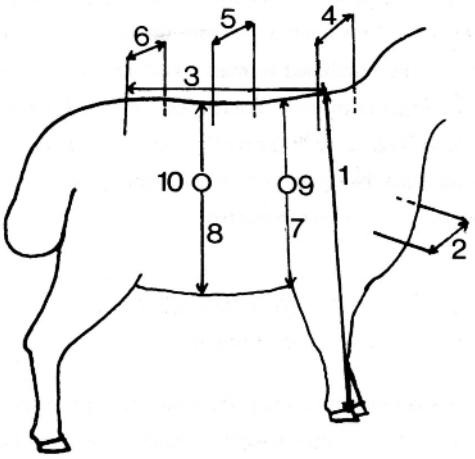

Fig. 1. Diagram showing the places which measurements were taken. Points at which circumferences were measured are shown by circles (see text).

group were creep-fed and received more milk since their dams were not milked and consequently had better nutritional condition. Interactions between the main factors were not tested because some of the subclasses did not have any observation and the amount of variation attributed to the interactions is believed to be relatively small. Data on twin-born ewes were excluded from the analysis because the number of observations in this group was very small and the purchased animals could not be classified on this factor. The differences among constants in each subclass were tested for significance with the multiple range test of Duncan (2) as modified by Kramer (6). Standard errors of different constants were calculated using the square root of the error mean squares and appropriate inverse elements of the variance-covariance matrix.

RESULTS AND DISCUSSION

Body Weight

Breed: Breed was the most influential of all the factors studied and had a highly significant effect ($P < .01$) on body weight at mating, lambing and weaning time. This factor accounted for 26.8, 37.3 and 33.3 percent of the total variation of body weight at mating, lambing and weaning, respectively (Table 1). All breeds differed significantly from each other in weight at mating (Table 2). Ghezel was the heaviest breed followed by Mehraban, Bakhtiari, Karakul and Naeini ewes. The breeds ranked in the same order in weight at lambing and weaning, but there was no significant difference in weights between Mehraban and Bakhtiari ewes at these stages. Comparison of the least squares means of the mature body weight of the breeds (Table 3) indicated that Ghezel can be classified as a heavy breed (59.1 kg), Mehraban, Bakhtiari and Karakul as medium (54.2, 53.3 and 51.0 kg, respectively and Naeini as a light breed (43.4 kg).

Age of Ewe: Age had a highly significant effect ($P < .01$) on body weight in all the stages (Table 1). This factor accounted for 9.9, 8.7 and 4.3 percent of the total

Table 1. Analysis of variance for ewe body weights at mating, lambing and weaning time (percent of variation)

Source of variation	Mating	Lambing	Weaning
Breed of ewe	26.8**	37.3**	33.3**
Age of ewe	9.9**	8.7**	4.3**
Year	4.2**	0.7**	5.4**
Type of rearing	1.7**	1.0**	0.6**
Percent of total variation accounted for by all the factors	42.6	47.7	43.6

** Significant at $P < .01$

Table 2. Least-squares constants and standard errors by breed, age of ewe, year and type of rearing for ewe body weights at mating, lambing and weaning time and test of significance for differences between constants

Main factor	Subclass	No. of ewes	Body weight at mating kg	Sub-class	No. of ewes	Body weight at lambing kg	No. of ewes	Body weight at weaning kg
Overall mean		2519	50.0 ± 0.2		1651	52.9 ± 0.3	1558	44.8 ± 0.3
	Karakul	524	−1.2 ± 0.4a	K	396	-2.0 ± 0.5a	376	-.9 ± 0.5a
	Mehraban	875	1.9 ± 0.2b	M	571	2.2 ± 0.3b	539	2.5 ± 0.3b
Breed	Naeini	505	-8.8 ± 0.3c	N	406	-10.9 ± 0.3c	381	- 9.6 ± 0.3c
	Ghezel	305	6.9 ± 0.4d	G	140	8.2 ± 0.5d	133	5.9 ± 0.5d
	Bakhtiari	310	1.1 ± 0.3e	B	138	2.5 ± 0.5b	129	2.0 ± 0.5b
	1.5	559	-.6.1 ± 0.3a	2	553	-4.8 ± 0.3a	520	- 3.4 ± 0.3a
	2.5	664	-1.8 ± 0.3b	3	373	-.9 ± 0.3b	351	-.6 ± 0.3b
	3.5	425	1.2 ± 0.3c	4	383	2.2 ± 0.3ce	366	1.1 ± 0.3c
Age (years)	4.5	440	2.2 ± 0.3d	5	192	2.4 ± 0.4c	181	1.5 ± 0.4c
	5.5	256	2.0 ± 0.3cd	6&7	150	1.1 ± 0.4de	140	1.3 ± 0.5c
	6.5 & 7.5	175	2.5 ± 0.4d					
	1973	350	3.1 ± 0.2a	1973	382	-1.1 ± 0.3a	375	-2.7 ± 0.3a
Year	1974	1019	-.7 ± 0.2b	1974	316	0.3 ± 0.3b	294	3.3 ± 0.3b
	1975	1150	-2.4 ± 0.2c	1975	953	0.8 ± 0.2b	889	.6 ± 0.2c
Type of	Purchased	1823	-1.7 ± 0.2a	Purchased	1193	1.6 ± 0.3a	1131	-1.2 ± 0.3a
rearing	Reared in the Station	696	1.7 ± 0.2b	Reared in the Station	458	1.6 ± 0.3b	427	1.2 ± 0.3b

All constants within each subclass differ significantly ($P < .05$) except those followed by the same letter.

Table 3. Least-squares means and standard errors for mature ewe body weight of the five breeds at mating, lambing and weaing times (in kilograms) [1]

Breed	Mating	Lambing	Weaning
Ghezel	59.1 ± 0.7	62.7 ± 0.9	52.2 ± 0.9
Mehraban	54.2 ± 0.4	56.6 ± 0.6	48.9 ± 0.6
Bakhtiari	53.3 ± 0.5	57.0 ± 0.8	48.3 ± 0.8
Karakul	51.0 ± 0.4	52.5 ± 0.5	45.5 ± 0.6
Naeini	43.4 ± 0.4	43.5 ± 0.6	36.8 ± 0.6

1. Each mean was calculated by addition of the overall means and the appropriate constants for breed and age at five years (4.5 years at mating time), since the means were adjusted only for year and type of rearing.

variations in weight of ewe at mating, lambing and weaning, respectively. The one-and-half year-old ewes had the lightest body weight at mating season and body weight gradually increased until it reached the maximum weight at four and a half years of age; then it remained statistically the same up to seven and a half years of age. The rate of increase in body weight was higher in the early stages of life and then declined gradually. The pattern of change in body weight in relation to the age of ewe at lambing and weaning time was more or less the same since the two-year-old ewes, which lambed for the first time, were the lightest and their body weights increased significantly up to the fourth year of age. Although the growth was continued until the fifth year of age, no significant difference was found between the four- and five-year-old age groups. Body weight decreased as age of the ewe increased beyond five years of age. The decline in weight due to the increase in age was only significant in the case of weight at lambing time.

The significant effect of age on body weight at breeding, lambing and weaning time of Rambouillet, Rommelet, Columbia, Targhee and Suffolk under range conditions was reported by Vasely *et al.* (14). Two-year-old ewes were the lightest and four-year-old animals were the heaviest group in their study, which is in agreement with the results obtained in this study.

Type of Rearing: Although the contribution of type of rearing to the total variation was relatively small, nevertheless the effect of this factor was highly significant ($P < .01$) on body weight of the ewes at mating, lambing and weaning times. The ewes born in the College Station and raised under more favorable conditions were significantly heavier at mating (3.5 kg), lambing (3.2 kg) and weaning (2.4 kg).

Milking the ewe, which is a common practice in Iran, was not practiced in the College Station, and was an important factor in production of heavier lambs which affected body weight in subsequent stages. The feed supplementation of ewe lambs before weaning and up to the first lambing can be considered as another factor in causing this differ-

ence. Gunn (4) evaluated the effect of level of nutrition of lamb between 3 and 6 months and between 6 and 12 months of age on subsequent growth to mature size of Scottish Blackface sheep. He found that the effect of treatment between 3 and 6 months of age was small at 30 and 42 months and had even virtually disappeared by 12 months of age, whereas the effect of treatments imposed between 6 and 12 months was considerable and created lasting and significant differences in subsequent body weights. This is partly in agreement with the results obtained in this experiment which indicated that favorable feeding conditions during the first year would have a significant effect on body weight in later stages.

Year of Recording: Year had a highly significant effect on body weight at mating, lambing and weaving time (Table 1). The percent of the total variation in weight due to year effect was 4.2, 0.7 and 5.4 at mating, lambing and weaning time, respectively. The results indicated that the effect of this factor on weight was more pronounced at weaning and mating time than at lambing. This might be expected since body weight at mating is highly affected by field and range conditions which were influenced greatly by year. Feed supplementation was either not practiced or was very low during the summer months. On the other hand the animals were mostly hand fed in winter and consequently the amount of feed was under the control and was held almost constant in different years. The ewes were mostly grazed on range and barley pasture during the nursing period and feed intake could not be controlled.

Relationship Between Body Weight in the First Mating and Weight in Subsequent Ages: Relationship between body weight of ewe in the first mating (1.5 year old) and body weight in the second and third mating was calculated within breed and type of rearing, and are presented in Table 4. There was a highly significant relationship between body weight in the first mating and body weights in the next two breeding seasons. Each kilogram increased in ewe body weight at the first mating resulted in 0.84 and 0.98 kg

Table 4. Relationship between one and half year-old ewe body weight and body weight in 2.5 and 3.5 years of age.

Dependent variable	No. of ewes	Correlation coefficient	Regression coefficient	$S_{y.x}$
2.5 year-old	393	0.78**	0.84**	4.15
3.5 year-old	21	0.85**	0.98**	4.86

**Significant at $P < .01$

$S_{y.x}$ Standard error of estimate

increase in body weight in the second and third mating,respectively. Nichols and Whiteman (8) found the correlation between yearling body weight and the average body weight over the next seven years to be 0.66, which, is somewhat lower than these estimates.

There was no significant deviation of the regression lines from linearity ($P < .01$).

Body Measurements

Breed: The percent of variation accounted for by different factors affecting body dimensions are presented in Tables 5 and 6. Breed had highly significant effects on 9 out of 10 measurements studied. The contribution of breed to the total variation of the different traits was very variable, ranging from 20.2 percent for the height at withers to 0.2 percent for the width at middle. Besides the height at withers, in which breed accounted for a considerable part of the total variation, breed was responsible for approximately 12 percent of the total variation of circumferences which were ranked next; the body horizontal distances were at the end of the list.

Ghezel was the tallest breed followed by Bakhtiari, Mehraban, Karakul and Naeini breeds which differed significantly from each other, except Bakhtiari and Mehraban (Table 7). The breeds ranked the same for height at withers as for body weight at lambing time. The order of the breeds in ranking for circumferences and width at shoulder was exactly similar to that of height at withers. Naeini had significantly the shortest body depths at midside and chest as compared with other breeds which did not show significant differences, except Ghezel which had the largest body depth at the midside. Except for the body width at the midside which did not show any breed differences, Naeini breed had consistently smallest body horizontal measurements (Table 8). It is of considerable interest to note that in widths at breast, shoulder, midside and hook, the Bakhtiari breed was wider than the Mehraban breed, but the differences were not significant, although the Mehraban was

is of variance for ewe body vertical measurements and circumferences at mating season (percent of variation)

Source of variation	Height at withers	Depth of chest	Depth of middle	Circumference of chest	Circumference of middle
Breed of ewe	20.2**	6.4**	7.4**	11.4 **	12.6**
Age of ewe	1.5**	2.6**	3.1**	3.7**	3.7**
Type of rearing	0.6**	0.3	0.9**	2.3**	1.6**
Percent of total variation accounted for by all the factors	22.3	9.3	11.4	17.4	17.9

** Significant at $P < .01$

Table 6. Analysis of variance for ewe body horizontal measurements at mating season (percent of variation)

Source of variation	Length, front of withers to hook bone	Width of breast	Width of shoulder	Width of middle	Hook width
Breed of ewe	8.1**	3.4**	4.8**	0.2	1.3**
Age of ewe	2.2**	0.3	0.1	0.2	0.2
Type of rearing	0.1	1.3**	0.9**	0.6**	0.3
Percent of total variation accounted for by all the factors	10.4	5.0	5.8	1.0	1.8

** Significant at $P < 0.1$

Table 7. Least-squares constants and standard errors by breed, age of ewe and type of rearing for ewe body vertical measurements and circumferences and test of significance for differences between constants (in centimeter).

Main factor	Subclass	No. of ewes	Height at withers	Depth of chest	Depth of middle	Circumference of chest	Circumference of middle
Overall mean		1087	68.8 ± 0.2	31.4 ± 0.1	34.5 ± 0.1	93.6 ± 0.3	105.9 ± 0.3
	Karakul	213	-.8 ± 0.4a	0.0 ± 0.2a	0.0 ± 0.2a	-2.2 ± 0.5a	-2.1 ± 0.6a
	Mehraban	387	0.7 ± 0.2b	0.4 ± 0.1a	0.3 ± 0.1a	1.1 ± 0.3b	2.0 ± 0.3b
Breed	Naeini	186	-5.2 ± 0.3c	-1.8 ± 0.2b	-1.8 ± 0.2c	-5.1 ± 0.4c	-5.5 ± 0.5c
	Ghezel	143	3.9 ± 0.4d	0.9 ± 0.3a	1.3 ± 0.2b	4.1 ± 0.6b	4.1 ± 0.6d
	Bakhtiari	158	1.3 ± 0.3b	0.4 ± 0.2a	0.1 ± 0.2a	2.0 ± 0.5b	1.4 ± 0.5b
	1.5	130	-1.2 ± 0.4a	-1.4 ± 0.3a	-1.2 ± 0.3a	-2.8 ± 0.6a	-3.6 ± 0.7a
	2.5	361	-.4 ± 0.3a	-1. ± 0.2b	-.4 ± 0.2b	-1.6 ± 0.4ab	-1.0 ± 0.4b
Age (year)	3.5	110	-.4 ± 0.4 ac	0.0 ± 0.2bc	0.1 ± 0.2bc	-.4 ± 0.5bc	-.7 ± 0.6b
	4.5	232	0.9 ± 0.3bc	0.7 ± 0.2c	0.7 ± 0.2c	1.5 ± 0.4d	1.4 ± 0.4c
	5.5	108	0.8 ± 0.4bc	0.5 ± 0.2bc	0.4 ± 0.2c	1.3 ± 0.6cd	1.8 ± 0.6c
	6.5 & 7.5	146	0.4 ± 0.4b	0.3 ± 0.2bc	0.4 ± 0.2c	2.0 ± 0.5d	2.0 ± 0.6c
Type of rearing	Purchased	773	-.7 ± 0.2a	-.3 ± 0.1a	-.5 ± 0.1a	-1.8 ± 0.3a	-1.6 ± 0.3a
	Reared in the Station	314	0.7 ± 0.2b	0.3 ± 0.1a	0.5 ± 0.1b	1.8 ± 0.3b	1.6 ± 0.3b

All constants within each subclass differ significantly ($P < 0.5$) except those followed by the same letter.

Table 8. Least-squares constants and standard errors by breed, age of ewe and type of rearing for ewe body horizontal measurements and test of significance for differences between constants (in centimeter)

Main factor	Subclass	No. of ewes	Length, front of withers to hook bone	Width of breast	Width of shoulder	Width of middle	Hook width
Overall mean		1087	44.8 ± 0.2	18.9 ± 0.1	18.0 ± 0.1	13.0 ± 0.1	19.4 ± 0.1
Breed	Karakul	213	0.9 ± 0.3ac	-.3 ± 0.2a	-.4 ± 0.2a	0.0 ± 0.2a	0.2 ± 0.2ab
	Mehraban	387	1.3 ± 0.2a	0.0 ± 0.1a	0.1 ± 0.1b	-.0 ± 0.1a	-.2 ± 0.1bc
	Naeini	187	-2.2 ± 0.3b	.9 ± 0.1b	-1.0 ± 0.1c	-.2 ± 0.1a	-.6 ± 0.2c
	Ghezel	143	0.2 ± 0.4dc	0.7 ± 0.2c	0.9 ± 0.2d	0.2 ± 0.2a	0.5 ± 0.3a
	Bakhtiari	158	-.2 ± 0.3d	0.4 ± 0.1c	0.3 ± 0.1b	0.0 ± 0.1a	0.1 ± 0.2ab
Age (Years)	1.5	130	-1.9 ± 0.4a	-.3 ± 0.2a	-.1 ± 0.2a	-.1 ± 0.2a	0.2 ± 0.3a
	2.5	361	0.0 ± 0.3b	0.0 ± 0.1a	-.1 ± 0.1a	0.1 ± 0.1a	0.1 ± 0.2a
	3.5	110	0.0 ± 0.3b	0.1 ± 0.2a	0.1 ± 0.2a	0.0 ± 0.2a	0.0 ± 0.2a
	4.5	232	0.3 ± 0.2bc	0.1 ± 0.1a	0.1 ± 0.1a	0.1 ± 0.1a	0.1 ± 0.2a
	5.5	108	0.7 ± 0.3bc	-.2 ± 0.2a	0.0 ± 0.2a	0.0 ± 0.2a	-.2 ± 0.2a
	6.5 & 7.5	146	1.0 ± 0.3c	0.2 ± 0.2a	0.0 ± 0.2a	-.1 ± 0.2a	-.2 ± 0.2a
Type of rearing	Purchased	773	-.2 ± 0.2a	-.4 ± 0.1a	-.3 ± 0.1a	-.3 ± 0.1a	-.3 ± 0.1a
	Reared in the Station	314	0.2 ± 0.2a	0.4 ± 0.1a	0.3 ± 0.1b	0.3 ± 0.1b	0.3 ± 0.1a

All constants within each subclass differ significantly ($P < .05$) except those followed by the same letter.

significantly heavier than the Bakhtiari at mating time. The body dimensions of the mature ewes of the breeds are presented in Table 9.

Age of Ewe: Age had a highly significant effect on all body vertical measurements (height and depths) and on circumferences. Distance between front of withers and hook bone was the only significant body horizontal measurement The contribution of age of the total variation was generally very small and accounted for approximately 3 per cent for depths and circumferences and less than 0.5 percent for the horizontal measurements.

The least-squares means of the different age groups showed that those animals which were bred for the first time as 1.5-year-old ewes, had significantly lower vertical dimensions and circumferences compared with those which were 3.5-year-old and older, except height at withers. No significant difference was observed between 4.5-year-old and the older age groups for any of the traits studied. These findings indicate that the growth of body vertical dimensions continued until 2.5 years, and for some measurements until 3.5 years of age, but the growth of body widths was completed at 1.5 years of age.

Type of Rearing: This factor was a significant source of variation in 7 out of 10 measured body dimensions. The contribution of the type of rearing to the total variation was very small and accounted for less than one percent in most traits. Those ewes which were born in the College Station had bigger measurements than the purchased groups, but the differences were not significant in depth of chest, body length (front of withers to hook bone) and hook width. Gunn (4) reported that the level of nutrition of the lamb between 6 and 12 months had a significant effect on body length, depth of chest and width of hip of the mature ewes.

Table 9. Least-squares means and standard errors for mature ewe body measurements of the five breeds (in centimeters)[1]

Breed	Height at withers	Width at breast	Length, front of withers to hook bone	Width of shoulder	Width of middle	Hook width	Depth of chest	Depth of middle	Circumference of chest	Circumference of middle
Ghezel	73.5 ± 0.6	19.7 ± 0.3	45.3 ± 0.6	19.1 ± 0.3	13.3 ± 0.3	20.0 ± 0.4	33.0 ± 0.4	36.5 ± 0.4	98.2 ± 0.4	111.9 ± 0.9
Mehraban	70.4 ± 0.4	19.0 ± 0.2	46.1 ± 0.3	18.2 ± 0.2	13.1 ± 0.2	19.3 ± 0.2	32.5 ± 0.2	35.5 ± 0.2	95.2 ± 0.2	109.8 ± 0.6
Bakhtiari	71.0 ± 0.6	19.4 ± 0.3	44.8 ± 0.5	18.4 ± 0.3	13.1 ± 0.3	19.5 ± 0.4	32.3 ± 0.4	35.3 ± 0.4	96.1 ± 0.9	109.1 ± 0.9
Karakul	68.8 ± 0.4	18.7 ± 0.2	45.9 ± 0.3	17.7 ± 0.2	13.1 ± 0.2	19.7 ± 0.2	32.1 ± 0.2	35.2 ± 0.2	91.8 ± 0.6	105.6 ± 0.6
Naeini	64.5 ± 0.4	18.1 ± 0.2	42.9 ± 0.4	17.2 ± 0.2	12.9 ± 0.2	18.8 ± 0.3	30.3 ± 0.3	33.4 ± 0.3	89.0 ± 0.6	102.2 ± 0.6

1. Means were calculated as described in Table 3.

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